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KamLAND Z-axis glove box nitrogen gas schematic and procedures.

DRAFT

The attached gas system schematic shows the gas system configuration used for purging the glove box and allowing the necessary source changing and system reconfiguration.

The gas system related procedures for common glove box tasks are shown below.

All glove box uses including purging, deployments, source changes, etc. should be logged in a glove box logbook. Relevant parameters such as dates, times, dome air radon concentration, etc. should be noted.

The gas system controls are located on two panels. The panel located on the glove box is called the Glove Box (GB) panel and the second panel mounted to the platform near the glove box is called the Gas Control (GC) panel. The following valves, pressure gauges and flow meters are located on the panels as shown.

Glove Box Panel - V_1, V_3, V_4, V_5, V_6, P_1, P_3, FM_2
Gas Control Panel - V_2, V_7, V_8, V_9, V_10, V_11, P_2, FM_1

Relevant Glove Box Gas System Parameters:

Glove box Volume: Approximately 0.3 cubic meters (~ 12 cubic feet)

Gas Pressure Relief Valve setting: 0.3 psi. (~9 inches of water = ~28 cm water)

Flow Meter Units: Standard cubic feet per hour (SCFH) range 6-60 (1 SCFH = 28.3 liters/hr)

Please see the attached sheet for conversion of meter readings to m^3 / hr .

Purge Amounts:

Radon in dome air (Bq/m^3)	GB Purge gas volume (m^3)
< 100	8 GB volumes = 2.4 m^3
$100 < n < 500$	12 GB volumes = 3.6 m^3
$500 < n$	16 GB volumes = 4.8 m^3

Dome air radon concentrations can be measured with the existing radon measuring apparatus on the chimney.

All procedures assume beginning with all valves on the GB panel and the GC Panel closed (except as indicated below) and the flex lines connected.

Initial Setup.

1. Open the main supply and return valves located on the chimney side and dome wall respectively.
2. Open V_9 and adjust the low pressure regulator to give approximately 2 psi. gas pressure as measured on pressure gauge P_2. Open valve V_11.
3. These settings should be maintained for the gas system procedures shown below.

Initial purging of the glove box and deploying a source.

(The initial purge also purges the volume between the 16" gate valve and the 6" gate valve. Subsequent purges can be done using the procedure listed for glove box only purging)

1. Install the desired source and close off all entrances to the glove box including both transfer box doors. The light shields should be in place.
2. Open the 6" gate valve.
3. Open valve V_6 and V_10.

4. Open valve V_3.
5. Adjust the flow rate through FM_1 with valve V_2 such that the pressure in the glove box does not rise above 3" of water. This can be measured on P_1 or P_4.
6. Allow a sufficient amount of nitrogen to flow through the system. This amount of nitrogen depends on the present radon concentration in the dome air. The necessary purge amount can be found at the beginning of this procedure. The flow can be metered through FM_1.
7. Close valves V_3 and V_1.
8. Allow the pressure in the glove box to decrease to within 2" of water of atmospheric pressure.
9. Close valve V_6.
10. Slowly open valve V_8 to equalize the pressures between the glove box volume and the detector volume.
11. Open the 16" gate valve. Close valve V_8.
12. The source is now ready to be deployed. If one wishes to rotate the glove box, the nitrogen supply and return flex lines allow at least +/- 180 degrees of rotary motion with the rotary stage.
13. After the calibration, with the source retracted into the glove box. Close the 16" gate valve.
14. Close the 6" gate valve.
15. The system is clean and secured.

Glove Box Only Purging

(This is the usual procedure to be followed after the volume between the 6" and 16" gate valves has been already purged.)

1. Install the desired source and close off all entrances to the glove box including both transfer box doors. The light shields should be in place.
2. Open valve V_6 and V_10.
3. Open valve V_3.
4. Adjust the flow rate through FM_2 with valve V_1 such that the pressure in the glove box does not rise above 3" of water. This can be measured on P_1 or P_4.
5. Allow a sufficient amount of nitrogen to flow through the system. This amount of nitrogen depends on the present radon concentration in the dome air. The necessary purge amount can be found at the beginning of this procedure. The flow can be metered through FM_2.
6. Close valves V_3 and V_1.
7. Allow the pressure in the glove box to decrease to within 2" of water of atmospheric pressure.
8. Close valve V_6.
9. Open the 6" gate valve.
10. Slowly open valve V_8 to equalize the pressures between the glove box volume and the detector volume.
11. Open the 16" gate valve. Close valve V_8.
12. The source is now ready to be deployed. If one wishes to rotate the glove box, the nitrogen supply and return flex lines allow at least +/- 180 degrees of rotary motion with the rotary stage.
13. After the calibration, with the source retracted into the glove box. Close the 16" gate valve.
14. Close the 6" gate valve.
15. The system is clean and secured.

Changing a source.

1. From the above state. Place a clean source into the transfer box opening only the outer door. Close the outer door.
2. Open valve V_5.
3. Open valve V_4.
4. Adjust the flow rate through FM_2 with valve V_1 such that the pressure in the transfer

- box does not rise above 5" of water. This can be measured on pressure gauge P_3.
5. Allow a sufficient amount of nitrogen to flow through the transfer box. The amount of purge nitrogen is related to the current level of radon in the dome air. For dome air radon concentrations $< 100 \text{ Bq/m}^3$ flow 0.226 m^3 of nitrogen. For dome air radon concentrations $100 \text{ Bq/m}^3 < n < 500 \text{ Bq/m}^3$ flow 0.340 m^3 of nitrogen. For dome air radon concentrations greater than 500 Bq/m^3 flow 0.453 m^3 of nitrogen. This flow is metered through FM_2 and controlled with valve V_1.
 6. Close V_4 and V_1.
 7. Allow the pressure in the transfer box to decrease to within 2" of water of the pressure in the glove box.
 8. Close valve V_5.
 9. Open the inner transfer box door and change the source.
 10. Place the old source in the transfer box and close the inner door.
 11. If desired, remove the old source from the transfer box using the outer transfer box door.
 12. Open the 6" gate valve. Replace the light shields.
 13. The source is now ready to deploy.

Some low frequency or unusual glove box activities can be anticipated. If one wishes to remove the glove box and preserve the clean state in the glove box, one can remove it by disconnecting the lower flange of the 6" gate valve. In this unusual activity, the glove box integrity is maintained through the 6" gate valve seal. When the glove box is returned it can be reattached and the volume between the 6" gate valve and the 16" gate valve purged using V_2, FM_1 and V_7.

If one wishes to remove the glove box and all of the flange stack above the 16" gate valve in anticipation of installing a 4-pi system that requires a large access port, one will need to put together a gas handling system particular to the particular needs of the 4-pi system design. The existing flex hose supply and return lines can serve this new system.

GB Flowmeter Conversion Chart

